Environmental Protection Agency

Heavy-Duty Engine Dynamometer Speed and Torque Calibration Procedure

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NVFEL Reference Number

251

Implementation Approval

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Revision Description

Table of Contents

1.	Purpose
2.	Test Article Description
3.	References
4.	Required Equipment
5.	Precautions4
6.	Visual Inspections4
7.	Test Article Preparation
8.	Test Procedure
	100 Shaft-Torque Daytronic Calibration
	200 Cellmate II Shaft-Torque Calibration
	300 Shaft-Torque Linearity Verification9
	400 Case-Torque Daytronic Calibration
	500 Cellmate II Case-Torque Calibration11
	600 Case-Torque Linearity Verification
	700 Speed Verification
9.	Data Input
10.	Data Analysis
11.	Data Output
12.	Acceptance Criteria
13.	Quality Provisions
	Attachments
Attachment A, Fo	orm 251-01, Heavy-Duty Dynamometer Speed and Torque Calibration 18
Attachment B. H	eavy-Duty Dynamometer Speed and Torque Calibration

1. Purpose

The purpose of this procedure is to ensure accurate dynamometer calibration by adjusting the torque measuring equipment to a known value introduced by hanging National Institute of Standards and Technology (NIST) -traceable weights on a lever arm. The resulting calibration is verified over the typical measurement range of the dynamometer.

This procedure also contains a verification of the speed measurement system, made by comparing readings from the speed signal and data acquisition system to a frequency counter used as a reference.

2. Test Article Description

Electric Engine Dynamometer, General Electric Model 42 G 408 AD

3. References

- 3.1 "Code of Federal Regulations," Title 40, Part 86, Subpart N, Sections 86.1308, 86.1316, and 86.1318
- 3.2 "Digalog Cellmate Toolbox User Manual"

4. Required Equipment

4.1 Electric Engine Dynamometer

Equipment used: General Electric Model 42 G 408 AD

4.2 Weights and hangers, certified traceable to NIST

Equipment used: Weights manufactured to Engineering Operation Division (EOD)

specifications

4.3 Balanced shaft-torque lever arm, 60.0 inches in overall length with an effective lever arm of 30.0 inches

Equipment used: Torque lever arm manufactured to EOD specifications

4.4 Case-torque lever arm with an effective lever arm of 36.0 inches

Equipment used: Torque lever arm provided with General Electric Model 42 G 408 AD dynamometer

4.5 Dynamometer Controller

Equipment used: Digalog Model Cellmate II

4.6 Speed and Torque Signal Conditioners

Equipment used: Daytronic Models, 9178A, 9140 ("Daytronic")

4.7 Digital Multi-Counter

Equipment used: Fluke Model 1900 Multi-Counter

4.8 Computer

Equipment used: Macintosh with Excel® application

- 4.9 Protractor level
- 4.10 Hydraulic lift
- 4.11 Form 251-01, "Heavy-Duty Dynamometer Speed and Torque Calibration" (Attachment A)

5. Precautions

- 5.1 Personnel handling the weights must wear protective footwear.
- 5.2 Never place feet or hands under hanging weights.
- 5.3 Always turn the power off to all three GE Cabinets, #2, #3 and #5, before opening their access doors.

6. Visual Inspections

All visual inspections are included as part of the test article preparation and procedure.

7. Test Article Preparation

- 7.1 Assemble the required weights, lever arm, digital multi-counter, hydraulic lift and Form 251-01. Inspect the calibration sticker on the digital multi-counter to ensure that it is in calibration.
- 7.2 Arrange for the test cell air handling unit to be turned off. Air currents will cause the weights to swing, making the readings unstable.
- 7.3 Disassemble the driveshaft from the dynamometer shaft.
- 7.4 Assemble the shaft-torque lever arm to the dynamometer shaft.
 - Align the bolt holes in the lever arm with those on the dyno shaft; insert three bolts and tighten them securely. Do not overtighten the bolts, as this may damage the aluminum arm.
- 7.5 Assemble the dyno lock to the rear of the dynamometer shaft. Use two bolts to secure the lock to the shaft. The legs of the lock have adjustable feet to secure it in place and prevent the shaft from rotating.
- 7.6 Using a protractor level, ensure that the arm is secured in a horizontal position, approximately 5 degrees higher on the side to which the weights will be added. The arm will deflect downward as the weights are added.
- **Note**: The dyno is typically calibrated for engines that rotate in a clockwise direction. The weights will be added to the right side of the lever arm (facing the dyno from the position of the engine.)
- 7.7 For ease of handling, arrange the weights in the order listed on Form 251-01. All weights are stamped with an identification number.
- 7.8 Ensure that the AC power is switched to Dyno 2. To verify or change power to the dynos:
 - 7.8.1 Turn the rotating switches on the front of G.E. Cabinet #2 labeled "AC DISCONNECT" and G.E. Cabinet #3 labeled "LINE SWITCH" to "OFF." Switch the circuit breaker on the side of G.E. Cabinet #5 to "OFF."

This step must be completed as a safety requirement to ensure that the power is off when opening the cabinet.

- 7.8.2 Open Cabinet #3 and check the position of the knife switches.
- 7.8.3 When the switches are to the right side, Dyno #1 is energized. When they are to the left side, Dyno #2 is energized. Move them to the proper position, if necessary.
- 7.8.4 Close the cabinet and switch the circuit breaker (Cabinet #5) "ON" and then turn the rotating switches "AC DISCONNECT" (Cabinet #2) and "LINE SWITCH" (Cabinet #3) "ON."

7.9 Activate the Cellmate II:

Note: The symbols <> are used to indicate a key on either the Cellmate II Computer Control System or Macintosh computer keyboards.

Example: Press <Return> to enter. This means that you need to press the key labeled "Return" to enter information typed on the computer screen.

- 7.9.1 Press the yellow power button on the Cellmate II front panel. It will illuminate when the power is "ON."
- 7.9.2 Press < Caps Lock>. Ensure that the LED on this key is illuminated.
- 7.9.3 The Cellmate II will prompt "hi." Respond by typing "HI" and press <Return>.

The Cellmate II will now load its programming. A red light to the right of the screen will blink while it is performing any operation. No entries can be made until it has completed this operation. The "TESTING MENU" will appear on the screen when the loading sequence is finished.

- 7.9.4 Press <2> <Return>. This will display the "TEST SEQUENCES" screen.
- 7.9.5 Press <2> <Return>. This will display the "TRANSIENT TESTS" screen.
- 7.9.6 Press <4> <Return>. This will display real-time measurements of test parameters.
- 7.9.7 Hold down <CTRL> and press <NEXT DISP> (upper left of keyboard).

 A new display will appear. Repeat <CTRL> <NEXT DISP> to move to the next screen which will display the shaft torque, case torque, and speed.

7.10 Press the green "START" button above the "MG SET" label. The button will illuminate when the motor/generator (MG) set is operating. Operating the MG set ensures that the dyno armature is floating on a film of oil.

8. Test Procedure

100 Shaft-Torque Daytronic Calibration

- On Form 251-01, in the box labeled "Prev. Shaft Torque Shunt Value," record the shunt value that is displayed on the sticker adjacent to the "Shaft Torque" Daytronic.
- Adjust the "Shaft Torque" Daytronic signal conditioner display to exactly 0.0 by rotating the "Fine Balance" potentiometer.
- Hang all the calibration weights on the shaft-torque lever arm. Refer to Form 251-01 for the weights to be used. Weights must not swing on the lever arm during calibration.
- Adjust the "Shaft Torque" Daytronic so the display matches the total moment created by the lever arm. To do this, adjust the span potentiometer so the display reads 1237.0. The Daytronic is adjustable to ± 0.5 .
- **Note:** All weights hanging on the lever arm will equal 494.74 lb x 2.5 ft = 1236.8 ft-lb.
- Using the hydraulic lift, raise the weights and the hanger off the lever arm clevis to recheck the zero calibration. Adjust the "Shaft Torque" Daytronic signal conditioner display to exactly 0.0, if necessary, by turning the "Fine Balance" potentiometer.
- Repeat Steps 102-105 for zero and span until the "Shaft Torque" Daytronic readings are correct and repeatable.
- 107 Press the "-CAL" button on the "Shaft Torque" Daytronic. The value that is displayed will be the new shunt calibration value. On a new adhesive sticker, record this value, your initials, and the date. Remove the old sticker and post the new sticker next to the display.
- On Form 251-01, record the new shunt calibration value in the box labeled "New Shaft Torque Shunt Value." This value should not differ by more than 5 percent from the "Prev Shaft Torque Shunt Value" unless repairs have been made or new equipment has been installed.
 - If it does differ by more than 5 percent, notify the Calibration and Maintenance (C&M) supervisor.

251	Heavy-Duty Engine Dynamometer
	Speed and Torque Calibration Procedure

Page 8 of 20

109	Remove the weights from the hanger, and set the weights and hanger aside.

Verify that the Cellmate II display for "SHAFT TORQUE" agrees exactly with the Daytronic reading for zero. Press the "-CAL" button on the "Shaft Torque" Daytronic, and again, ensure that the readings on the two displays agree exactly.

If the readings do not agree, proceed with Section 200.

If the readings agree, proceed with Section 300.

200 Cellmate II Shaft-Torque Calibration

This section should only be used if the "SHAFT TORQUE" readings on the Cellmate II display did not agree with the "Shaft Torque" Daytronic readings for the zero and span as observed in Section 100.

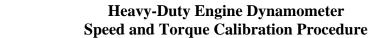
- 201 Press <MENU>. This will display the "TESTING MENU" screen.
- 202 Press <1><Return>. This will display the calibration screen.
- Using <PAGE¹>, scroll to the calibration screen that displays "TORQUE."
- Using $\langle \uparrow \rangle$ or $\langle \downarrow \rangle$, scroll to "TORQUE." It will become highlighted.
- 205 Press < Return > on the Cellmate II keyboard to enter the calibration mode.
- 206 Enter your initials and press < Return>.

Note: If at any point you do not want to change an entry on the Cellmate II, press <Return> and the entry currently on the screen will be retained.

207 Enter the transducer serial number and press < Return>.

Note: This number only needs to be changed if the transducer is replaced.

- With the weights raised off the clevis, and the "Shaft Torque" Daytronic display reading 0.0, press <Return> to enter the zero calibration into the Cellmate II.
- Enter "0.0" and press < Return > to enter the appropriate value in the "Low Engineering Value" field.

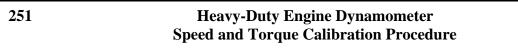


251

Page 9 of 20

210	Press and hold the "Shaft Torque" Daytronic "+CAL" button to display the new shunt value. With the "Shaft Torque" Daytronic reading the shunt value, press <return> to enter the high value of the calibration into the Cellmate II.</return>
211	Type the shunt value displayed on the "Shaft Torque" Daytronic in the "High Engineering Value" field. Hold down the Daytronic "+Cal" button and press <return>.</return>
212	The Cellmate II will prompt: "Comments?" Enter comments as necessary.
213	The Cellmate II will prompt:
	"Do you wish to review or change any answers? (Y/N) " Press $<$ Y $>$ $<$ Return $>$ to review or change, or $<$ N $>$ $<$ Return $>$ to end the shaft torque calibration.
214	When the Cellmate II calibration has been completed, press <menu>, this will display the "TESTING MENU" screen.</menu>
215	Press <2> <return>. This will display the "TEST SEQUENCES" screen.</return>
216	Press <2> <return>. This will display the "TRANSIENT TESTS" screen.</return>
217	Press <4> <return>. This will display real-time measurements of test parameters.</return>
218	Hold down <ctrl> and press <next disp=""> (upper left of keyboard). A new display will appear. Repeat <ctrl> <next disp=""> to move to the next screen which will display the shaft torque, case torque, and speed.</next></ctrl></next></ctrl>
300	Shaft-Torque Linearity Verification
301	Place the hanger on the lever arm clevis and add Weights 2R and 4R. The weights must not swing on the lever arm during verification.
302	On Form 251-01, record the value displayed on the Daytronic, on the line labeled "Hanger, 2R, 4R," and the column labeled "Daytronic Shaft Torque."
303	On the same line under "Cellmate Shaft Torque," record the shaft-torque value displayed on the Cellmate II.
304	Add weights 5R, 6R, and 7R on the hanger.

On Form 251-01, record the shaft-torque values displayed on the Daytronic and Cellmate II in the corresponding lines and columns.



Page 10 of 20

305 Continue adding weights on the hanger, and recording the values on the corresponding lines on Form 251-01, until the complete set has been added. 306 After all the weights have been placed on the hanger, and the readings have been recorded, remove the top two weights (this should be weights 23S and 24S). 307 On Form 251-01, record the shaft torque values from the Daytronic and Cellmate II on the corresponding lines. 308 Continue removing weights and recording the values until no weight remains on the lever arm. 309 Verify that the shaft-torque values displayed on both the Daytronic and Cellmate II are 0.0 ± 0.5 . If this tolerance is not met, repeat Steps 102 through 309. 310 Remove the lever arm and dyno lock from the dyno shaft. 311 Again, verify that the shaft-torque values displayed on both the Daytronic and Cellmate II are 0.0 ± 0.5 . If this tolerance is not met, investigate possible lever arm imbalance and repeat Steps 102 through 309. If this tolerance still cannot be met, notify the C&M supervisor.

400 Case-Torque Daytronic Calibration

- On Form 251-01, record the shunt value that is displayed on the adhesive sticker adjacent to the "Case Torque" Daytronic, in the box labeled "Prev Case Torque Shunt Value."
- Adjust the "Case Torque" Daytronic signal conditioner display to exactly 0.0 by rotating the "Fine Balance" potentiometer.
- Hang all the calibration weights to be used on the case-torque lever arm. Refer to Form 251-01 for the weights to be used.

Remove hysteresis from the load cell by tapping its base with a rubber mallet after adding or removing any weight.

- Adjust the "Case Torque" Daytronic, so the display matches the total moment created by the lever arm. To do this, adjust the span potentiometer so the display reads 1484.0. The Daytronic is adjustable to ± 0.5 .
- **Note:** All weights hanging on the lever arm will equal 494.74 lb x 3.0 ft = 1484.2 ft-lb.
- Using the hydraulic lift, raise the weights and the hanger off the lever arm clevis to recheck the zero calibration. Adjust the "Case Torque" Daytronic to exactly 0.0, if necessary, by rotating the "Fine Balance" potentiometer.
- Repeat Steps 402-405 for zero and span until the "Case Torque" Daytronic readings are correct and repeatable.
- 407 Press the "+CAL" button on the "Case Torque" Daytronic. The value that is displayed will be the new shunt calibration value. On a new adhesive sticker, record this value, your initials, and the date. Remove the old sticker and post the new sticker next to the display.
- On Form 251-01, record the new shunt calibration value in the box labeled "New Case Torque Shunt Value." This value should not differ by more than 5 percent from the "Prev Case Torque Shunt Value" unless repairs have been made or new equipment has been installed. If it does differ by more than 5 percent, notify the C&M supervisor.
- Remove the weights from the hanger, and set the weights and hanger aside.
- Verify that the Cellmate II display for "CTORQUE" agrees exactly with the Daytronic reading for zero. Press the "+CAL" button on the "Case Torque" Daytronic and ensure that the readings on the two displays agree exactly.
 - If they do not agree, proceed with Section 500.
 - If the readings agree, proceed with Section 600.

500 Cellmate II Case-Torque Calibration

This section should only be used if the "CTORQUE" readings on the Cellmate II display did not agree with the "Case Torque" Daytronic readings for the zero and span as observed in Section 400.

Press <MENU>. This will display the "TESTING MENU" screen.

251	Heavy-Duty Engine Dynamometer
	Speed and Torque Calibration Procedure

Page 12 of 20

502	Press <1> <return>. This will display the calibration screen.</return>
503	The first "CAL SCREEN" will display "CTORQUE."
504	Using <↓>, scroll to "CTORQUE." It will become highlighted.
505	Press <return> on the Cellmate II keyboard to enter the calibration mode.</return>
Note:	If you do not want to change an entry on the Cellmate II, press <return> and it will retain the entry currently on the screen.</return>
506	Type your initials and press <return>.</return>
507	Type the transducer serial number and press <return>.</return>
Note:	This number only changes if the transducer is replaced.
508	With the weights raised off the clevis, and the "Case Torque" Daytronic display reading 0.0, press <return> to enter the zero calibration into the Cellmate II.</return>
509	Enter "0.0" and press <return> to enter the zero value in the "Low Engineering Value" field.</return>
510	Press and hold the "Case Torque" Daytronic "+CAL" button to display the new shunt value. With the "Case Torque" Daytronic reading the shunt value, press <return> to enter the high value of the calibration into the Cellmate II.</return>
508	Type the shunt value displayed on the "Case Torque" Daytronic in the "High Engineering Value" field. Hold down the Daytronic "+Cal" button and press <return>.</return>
509	The Cellmate II will prompt: "Comments?" Enter comments as necessary.
510	The Cellmate II will prompt:
	"Do you wish to review or change any answers? (Y/N) " Press $<$ Y $>$ $<$ Return $>$ to review or change or $<$ N $>$ $<$ Return $>$ to end the case torque calibration.
511	When the Cellmate II calibration has been completed, press <menu>, this will display the "TESTING MENU" screen.</menu>
512	Press <2> <return>. This will display the "TEST SEQUENCES" screen.</return>

251	Heavy-Duty Engine Dynamometer Page 13 of 20 Speed and Torque Calibration Procedure
513	Press <2> <return>. This will display the "TRANSIENT TESTS" screen.</return>
514	Enter <4> <return>. This will display the real-time measurements of test parameters.</return>
515	Hold down <ctrl> and press <next disp=""> (upper left of keyboard). A new display will appear. Repeat <ctrl> <next disp=""> to move to the next screen which will display the shaft torque, case torque, and speed.</next></ctrl></next></ctrl>
600	Case-Torque Linearity Verification
601	Place the hanger on the lever arm clevis and add Weights 2R and 4R. Weights must not swing on the lever arm during verification.
602	On Form 251-01, record the value displayed on the Daytronic, on the line labeled "Hanger, 2R, 4R," and the column labeled "Daytronic Case Torque."
603	On the same line under "Cellmate Case Torque," record the case-torque value displayed on the Cellmate II.
604	Add weights 5R, 6R, and 7R on the hanger.
	On Form 251-01, record the case torque values displayed on the Daytronic and Cellmate II in the corresponding lines and columns.
605	Continue adding weights on the hanger, and recording the values on their corresponding lines on Form 251-01, until the complete set has been added.
606	After all the weights have been placed on the hanger and the readings have been recorded, remove the top two weights (this will be weights 23S and 24S).
607	On Form 251-01, record the case-torque values from the Daytronic and Cellmate II on the corresponding lines.
608	Continue removing weights and recording the values until no weight remains on the lever arm.
609	Verify that the case-torque values displayed on both the Daytronic and Cellmate II are 0.0 ± 0.5 .
	If this tolerance is not met, repeat Steps 402 through 609.

251

Heavy-Duty Engine Dynamometer Speed and Torque Calibration Procedure

When the verification is complete, return the weights to their storage location.

700 Speed Verification

The speed measurement system is typically very stable and does not require adjustment. If the equipment fails any part of this verification, it should be taken out of service and a possible equipment malfunction should be investigated.

- Verify that the Cellmate II display for "SPEED" agrees exactly with the Daytronic reading for the zero.
- Press and hold the "SPAN" button on the "SPEED" Daytronic. Verify that the Cellmate II display for "SPEED" agrees exactly with the Daytronic reading for span.
- Unplug the rotary transformer speed sensor cable (the smaller of two cables) from the dynamometer shaft-torque transducer.
- Connect the Fluke multi-counter to the transducer using the cable labeled "Dyno Cal," which is stored in the large tool box in the test cell.
- Press the "Freq" and "Auto" buttons on the counter. The counter will automatically set itself to the correct scale to measure the dynamometer revolutions per minute.
- Turn the "AUTO/MANUAL" switch on the Cellmate II to the "MANUAL" position.
- 707 Turn the dyno "POWER" switch to the "ON" position.
- Turn the "FUEL/IGNITION" switch to the "ON" position.
- Press the "RESET" button. This will cause the green "FUEL ON" light to illuminate.
- Press the "DYNO ON" button. This will cause it to illuminate.
- 711 Turn the variable voltage power supply unit to "OFF."
- 712 Press the "MANUAL" button on the dyno control panel.
- Control the dyno rpm with the "SPEED" potentiometer on the right side of the control panel. Speed will be set by observing the multi-counter display and adjusting the speed to exactly those speeds shown on Form 251-01.

Verify the accuracy of the "SPEED" Daytronic display and the Cellmate II display by operating the dynamometer at 200 rpm and then from 500 to 4500 rpm at 500 rpm increments. Compare the readings at each point to the readings on the multicounter display.

On Form 251-01, record the readings under the columns labeled "Daytronic Speed" and "Cellmate Speed."

Both the Daytronic and Cellmate II readings must be within ± 2 percent of the multi-counter readings.

- 715 Turn the "POWER" switch on the dyno control panel to "OFF."
- 716 Turn the "FUEL/IGNITION" switch to "OFF."
- 717 Press the "MG SET" "STOP" button.
- When verification is complete, reinstall the sensor cable into the transducer and return the multi-counter and connection cable to their storage areas.
- End the calibration procedure on the Cellmate II:

Press <MENU>. The "TESTING MENU" will appear on the screen.

Press <6> <Return>.

Leave the Cellmate II power "ON."

9. Data Input

- 9.1 The technician will enter all calibration and verification data required on Form 251-01.
- 9.2 For each Daytronic torque signal conditioner, the technician will put his/her initials, the date, and the new shunt calibration value on an adhesive sticker and post the sticker next to the signal conditioner.
- 9.3 The technician will enter all data from Form 251-01 into the Excel® spreadsheet upon completion of the calibration.
 - 9.3.1 Locate a Macintosh computer that has access to the Labrotory Network System (LNS).
 - 9.3.2 Sign on to the LNS Production Server.

- 9.3.3 Open the "C&M" folder, then open the "TP 251 (Dyno Cal)" folder.
- 9.3.4 Open the "Speed and Torque Cal Report" spreadsheet.
- 9.3.5 Transcribe the data from Form 251-01 to the spreadsheet. When it is complete, print the spreadsheet for review. Printing the spreadsheet creates the "Heavy-Duty Speed and Torque Calibration Report."
- 9.3.6 Save the completed file as "Speed and Torque Cal Report mm/dd/yy" with the date included in the title.
- 9.3.7 Close the file and the "TP 251 (Dyno Cal)" folder and sign off of LNS.

10. Data Analysis

- 10.1 The technician will check Form 251-01 and the "Heavy-Duty Speed and Torque Calibration Report" for transcription accuracy.
- 10.2 The computer automatically compares the observed torque value to the theoretical or calculated value and calculates the percent deviation for each point. The technician will review the computer printout to ensure that all acceptance criteria have been met.
 - If all acceptance criteria have been met, the technician signs and dates Form 251-01.
- 10.3 A technician other than the technician who entered the data, reviews Form 251-01 and the "Heavy-Duty Speed and Torque Calibration Report" for transcription accuracy to ensure that all acceptance criteria are met. If this verification is successful, the technician signs and dates the "Heavy-Duty Speed and Torque Calibration Report."
 - If all acceptance criteria have been met, the equipment may be placed back in service.

If the acceptance criteria have not been met, the equipment must be taken out of service until it can be adjusted, repaired, or replaced and the verifications outlined in this procedure are completed successfully.

11. Data Output

The completed Form 251-01 and the "Heavy-Duty Speed and Torque Calibration Report" are filed in the C&M Department Calibration File.

12. Acceptance Criteria

- 12.1 The torque values indicated on the Cellmate II and the Daytronic signal conditioners must be within ±3 percent or 10 ft-lb of the calculated value, whichever is less, for each point.
- 12.2 The speed values indicated on the Cellmate II and the "Speed" Daytronic both must be within 2 percent of the Fluke multi-counter readings.
- 12.3 Final zero-point torque readings must be within ± 0.5 ft-lb on both the Cellmate II and Daytronic readouts.

13. Quality Provisions

- 13.1 Weights must not swing on the lever arm during a calibration.
- 13.2 Speed and Torque calibrations on the dynamometer must be performed monthly or whenever any portion of the torque or speed measurement system is repaired or replaced.
- 13.3 Speed and torque signals are checked for accuracy and linearity throughout their entire working range.
- 13.4 The calibration weights must be traceable to NIST standards.

Heavy-Duty Dynamometer Speed and Torque Calibration

Heavy-Duty Engine Dynamometer Speed and Torque Calibration Procedure

Attachment A

Weight ID	NIST Weight	Daytronic Shaft		Daytronic Case	Cellmate Case	Multi- Counter	Daytronic	Cellmate
Numbers	(11)	Torque (ft-1b)	Torque (ft-1b)	Torque (ft-1b)	Torque (ft-1b)	Speed (rpm)	Speed (rpm)	Speed (rpm)
	0.00					200		
Hanger, 2R, 4R	24.675					500		
5R, 6R, 7R	54.538					1000		
S8 ' 88	89.792					1500		
95, 105	140.548					2000		
115, 125	191.627					2500		
135,145	242.020					3000		
155, 165	292.802					3500		
175, 185	343.282					4000		
195, 205	393.757					4500		
215, 225	444.378							
235, 245	494.739					Shaft	Shaft Torque Shunt Yalue	t Yalue
						Previous		
235, 245	494.739					New		
215, 225	444.378							
195, 205	393,757					Case 1	Torque Shunt Yalue	: Yalue
175, 185	343.282					Previous		
155, 165	292.802					New		
135,145	242.020							
115, 125	191.627					Comments		
95, 105	140.548							
S8, 8S	89.792							
5R, 6R, 7R	54.538							
Hanger, 2R, 4R	24.675							
	00'0							

I have performed this calibration in accordance with TP 251.

Technician Signature

Date

Form 251-01: 12-19-94

HEAVY-DUTY SPEED AND TORQUE CALIBRATION REPORT 12/13/94

Heavy-Duty Engine Dynamometer Speed and Torque Calibration Procedure

Attachment B

NIST Weight Torque Torqu			Total	Calc. Case	Catc. Shaft	Daytronic Shaft	Cellmate Shaft	Daytronic Shaft Cellmate Shaft Daytronic Case	Cellmate Case	Daytronic Shaft	
(Ib) (Ib) (It-lb)	 ≘	NIST Weight	NIST Weight	Torque	Torque	Lordue	Fordue	Torque	Torque	Torque Offset	% diff.
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0		(lb)	(q _I)	(ft-1b)	(ft-lb)	(ft-1b)	(ft-1b)	(ft·lb)	(ft-1b)	(ft-1b)	
24.675 24.675 74.0 61.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0			,		,	J		A			
29.653 54.538 163.6 61.7 61.0 29.853 54.538 163.6 61.7 61.0 50.755 140.549 421.6 224.5 224.0 50.382 292.802 726.1 605.0 607.0 50.383 242.020 726.1 605.0 607.0 50.481 343.282 1029.8 858.2 860.0 50.481 343.282 1029.8 858.2 860.0 50.380 494.739 1484.2 1236.8 1225.0 50.380 494.739 1484.2 1236.8 1225.0 50.380 494.739 1484.2 1236.8 1225.0 50.481 343.282 1029.8 858.2 858.2 859.0 50.481 343.282 1029.8 858.2 859.0 50.493 242.020 726.1 605.0 607.0 50.493 242.020 726.1 605.0 607.0 50.493 242.020 726.1 605.0 607.0 50.494 398 41.39 1484.2 1236.8 1225.0 50.494 398 41.39 1484.2 1236.8 1225.0 50.495 44.379 1484.2 1236.8 1225.0 50.406 494.739 1484.2 1236.8 1225.0 50.407 393.757 1181.3 984.4 983.0 50.408 494.739 1484.2 1236.8 1225.0 50.408 494.739 1484.2 1236.8 1225.0 50.409 494.739 1484.2 1236.8 1225.0 50.409 494.739 1484.2 1236.8 1225.0 50.409 494.739 1484.2 1236.8 1225.0 50.70 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
29.653 64.538 163.6 136.3 137.0 50.755 140.548 421.6 3514 352.0 50.755 140.548 421.6 3514 352.0 50.333 242.020 726.1 605.0 607.0 50.481 343.282 1029.8 878.4 732.0 50.481 343.282 1029.8 878.4 732.0 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.350 444.376 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.481 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 50.481 393.757 1181.3 984.4 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50 60.50	Z, #	24.675	24.675	74.0	61.7	61.0	61.4	74.0	74.2	-0.7	.1.1%
35.255 99.792 269.4 224.5 224.0 50.755 140.548 421.6 351.4 352.0 50.755 140.548 421.6 351.4 352.0 50.393 242.020 726.1 605.0 607.0 50.782 292.802 726.1 605.0 607.0 50.782 292.802 726.1 605.0 607.0 50.481 393.757 1181.3 984.4 984.0 50.622 444.378 1333.1 1110.9 1109.0 50.622 444.378 1333.1 1110.9 1109.0 50.360 494.739 1484.2 1236.8 1109.0 50.361 494.739 1484.2 1236.8 1109.0 50.474 393.757 1181.3 984.4 983.0 50.481 343.282 1029.8 858.2 859.0 50.474 393.22 1029.8 858.2 859.0 50.474 343.27 1181.3 344.4	Ή.	29.863	54.538	163.6	136.3	137.0	136.9	164.0	164 1	0.7	0.48%
50.755 140.548 4216 351.4 352.0 50.782 191.627 724.9 479.1 479.1 50.382 292.802 726.1 605.0 607.0 50.782 292.802 878.4 732.0 775.0 50.441 393.757 1181.3 984.4 984.0 50.474 393.757 1181.3 984.4 984.0 50.360 494.739 1484.2 1236.8 1109.0 50.360 494.739 1484.2 1236.8 1109.0 50.474 393.757 1181.3 984.4 983.0 50.474 393.757 1181.3 984.4 983.0 50.474 393.757 1181.3 984.4 983.0 50.474 393.757 1181.3 984.4 983.0 50.474 393.757 1181.3 984.4 983.0 50.782 292.802 878.4 421.6 605.0 50.782 19.42.6 351.4 421.6 <t< td=""><td>Ω</td><td>35,255</td><td>89,792</td><td>269.4</td><td>224.5</td><td>224.0</td><td>224.3</td><td>269.5</td><td>269.5</td><td>-0.5</td><td>-0.21%</td></t<>	Ω	35,255	89,792	269.4	224.5	224.0	224.3	269.5	269.5	-0.5	-0.21%
51.079 191.627 574.9 479.1 479.0 50.393 242.020 726.1 606.0 50.481 343.282 1029.8 878.4 732.0 50.481 343.282 1029.8 878.4 735.0 50.360 494.739 1484.2 1286.8 1109.9 50.360 494.739 1484.2 1286.8 1109.0 50.360 494.739 1484.2 1286.8 1109.0 50.481 343.282 1029.8 858.2 858.0 50.481 343.282 1029.8 858.2 858.0 50.481 343.282 1029.8 858.2 858.0 50.393 242.020 726.1 605.0 607.0 50.393 242.020 726.1 605.0 607.0 50.393 245.7 74.0 61.7 615.5 22.863 89.792 269.4 224.5 136.3 24.675 24.675 74.0 61.7 615.5 24.675 24.675 74.0 61.7 615.5 24.675 24.675 74.0 61.7 615.5 24.675 24.675 74.0 61.7 615.5 24.675 140.348 138.8 25.5237 24.675 24.675 74.0 61.7 615.5 24.675 24.675 74.0 61.7 615.5 24.675 24.675 74.0 61.7 615.5 24.675 26.43 863.8 25.226.8 25.200871 135.8 25.2205 88.8 25.22028 88.8 25.22028 88.8 10.00126 188.8 25.22028 88.8 25.22034 225.8 25.52314 225.8 25.52314 225.8 25.52314 225.8 25.50344 235 25.2205 25.5034 235 25.2205	So	50.755	140.548	421.6	351.4	352.0	351.5	421.5	421.4	90	28.0
50.393 242.020 726.1 605.0 50.782 292.802 778.1 607.0 50.44 343.282 1029.8 658.2 50.474 393.757 1181.3 984.4 50.622 444.378 1333.1 1110.9 50.622 444.378 1333.1 1110.9 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.360 494.739 1484.2 1236.8 50.481 343.282 1029.8 858.2 50.481 343.282 1029.8 858.2 50.782 296.2 874.4 983.0 50.783 292.02 874.4 352.6 50.784 431.6 136.3 137.4 50.755 140.548 431.6 136.3 24.675 74.0 61.7 61.7<	83	51.079	191.627	574.9	479.1	479.0	479.3	575.0	575.2	- C	-0.14%
50.782 292.802 878.4 732.0 735.0 50.441 394.32.82 1029.8 858.2 860.0 50.441 394.32.82 1029.8 858.2 860.0 50.622 444.376 1181.3 984.4 984.0 50.622 494.739 1484.2 1236.0 1235.0 50.360 494.739 1484.2 1236.8 1109.0 50.360 494.739 1484.2 1236.8 1109.0 50.622 444.378 1181.3 984.4 984.0 50.622 444.378 1181.3 984.4 985.0 50.722 1181.3 984.4 983.0 1109.0 50.782 292.902 874.4 193.0 1109.0 50.782 140.549 421.6 351.4 362.0 50.755 140.549 421.6 351.4 362.0 50.755 140.549 421.6 351.4 362.0 50.755 140.549 421.6 351.4	45	50.393	242.020	726.1	605.0	607.0	607.1	728.0	728.1	2.0	30%
50.481 343.282 1029.8 858.2 860.0 50.474 393.757 1181.3 984.4 984.0 50.362 494.739 1484.2 1236.8 860.0 50.362 494.739 1484.2 1236.8 1109.0 50.022 444.376 1181.3 984.4 983.0 50.474 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.392 242.020 726.1 605.0 607.0 50.795 191.627 574.9 479.1 480.0 50.755 194.75 74.0 61.7 615.5 24.675 24.675 74.0 61.7 61	SS	50.782	292.802	878.4	732.0	735.0	735.5	884.5	881.3	o c	0.41%
50.474 393.757 1181.3 984.4 984.6 50.622 444.378 1191.3 1100.9 1109.5 50.360 494.739 1484.2 1236.9 1109.5 50.360 494.739 1484.2 1236.9 1109.5 50.362 444.376 1133.1 1110.9 1109.5 50.481 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.782 292.802 1029.8 858.2 1109.0 50.782 292.802 197.4 732.0 734.5 50.782 191.627 57.6 479.1 480.0 51.079 191.627 57.6 479.1 480.0 50.755 140.548 421.6 574.5 56.1 22.4675 74.0 61.7 61.7 61.7 24.675 74.0 61.7 61.7 61.7<	8	50,481	343.282	1029.8	858.2	860.0	850.1	1030.5	1031.0	, a	3,5
50.622 444.378 1333.1 1110.9 1109.5 50.360 494.739 1484.2 1236.8 1235.0 50.360 494.739 1484.2 1236.8 1235.0 50.622 444.378 1333.1 1110.9 1109.0 50.622 444.378 1333.1 1110.9 1109.0 50.622 444.378 1333.1 1110.9 1109.0 50.744 343.282 1029.8 856.2 855.0 50.782 292.002 674.4 732.0 734.5 50.783 140.549 421.6 351.4 430.0 50.755 140.549 421.6 351.4 430.0 50.755 140.549 421.6 351.4 430.0 50.755 140.549 421.6 351.4 430.0 50.755 140.549 421.6 351.4 430.0 50.755 140.549 421.6 351.4 430.0 50.755 24.675 74.0 61.7	SOS	50.474	393.757	1181.3	984.4	984.0	984.3	1182 5	1182 4	. c	8 9 9
50.360 494.739 1484.2 1236.8 1225.0 50.360 494.739 1484.2 1236.8 1225.0 50.622 444.378 1181.3 984.4 983.0 50.474 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.782 292.802 979.8 652.2 734.5 50.783 242.02 726.1 605.0 607.0 50.785 140.548 421.6 351.4 322.5 50.785 140.548 421.6 351.4 322.5 50.785 140.548 421.6 351.4 322.5 24.675 140.548 421.6 351.4 322.5 24.675 269.4 224.5 667.0 607.0 0.0 0.0 0.0 0.0 0.0 1.0 0.0 0.0 0.0 0.0 2.24.675 1.36.3 25.23.0 48.7 2.4675 <td>ĸ</td> <td>50,622</td> <td>444,378</td> <td>1333.1</td> <td>1110.9</td> <td>1109.5</td> <td>1109 7</td> <td>1332.0</td> <td>1332 2</td> <td>7 7</td> <td>200</td>	ĸ	50,622	444,378	1333.1	1110.9	1109.5	1109 7	1332.0	1332 2	7 7	200
50.360 494.739 1484.2 1236.8 1235.0 50.622 444.378 1181.3 984.4 1109.0 50.474 393.757 1181.3 984.4 1109.0 50.481 343.282 1029.8 858.2 883.0 50.782 292.802 878.4 732.0 607.0 60.393 242.020 726.1 605.0 607.0 51.079 191.627 574.9 479.1 430.0 50.785 140.548 421.6 352.5 29.863 34.538 143.6 136.3 24.675 269.4 224.5 224.5 24.675 74.0 61.7 61.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	248	50.360	494.739	1484.2	1236.8	1235.0	1235.1	1481,5	1481.7	# # # # # # # # # # # # # # # # # # #	-0.15%
50.622 444.378 1333.1 1110.9 110.9 50.474 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.782 292.802 978.4 732.0 673.0 60.393 242.020 726.1 605.0 607.0 51.079 191.627 574.9 479.1 4491.0 50.785 140.548 421.6 352.5 589.7 29.863 34.538 183.6 136.3 137.6 24.675 24.675 74.0 61.7 61.5 0.0 0.0 0.0 0.0 0.0 Mach LD Weight LD Weight LD Weight LD Hanger = 0.5.00871 135 = 25.5237 24.875 24.875 R = 0.5.00871 135 = 25.2205 87.2002 SR = 0.0.0086644 135 = 25.2205 88.8 25.2205 SR = 0.0.008664 158 = 25.2205 88.8 25.2002 SR = 0.0.008664 158 = 2	248	50,360	494.739	1484.2	1236.8	1235.0	1235 9	1491 5	14817	•	94
56.474 393.757 1181.3 984.4 983.0 50.481 393.757 1181.3 984.4 983.0 50.481 343.282 1029.8 858.2 858.2 859.0 50.482 22.802 878.4 732.0 6773.6 60.393 242.202 726.1 605.0 607.0	SSS	50.622	444 378	1333.1	1110	1100 0	1 100 0	20001	7 000 +	. ·	200
50.481 343.282 1020.8 858.2 858.0 50.782 292.802 878.4 732.0 734.6 50.783 242.020 726.1 605.0 607.0 51.075 140.548 421.6 351.4 480.0 50.75 140.548 421.6 351.4 480.0 35.255 89.792 228.4 5226.0 226.0 29.863 54.538 163.6 117.5 61.7 61.5 24.675 24.675 74.0 61.7 61.7 61.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 AMSON ID Weight ID Weight ID Weight ID Weight ID Weight ID Hanger = 0.500871 145 = 24.87564 25.2237 25.2026 8 R = 0.009871 152 = 25.2026 8 25.2026 8 R = 10.01902 163 = 25.2026 8 <td< td=""><td>i i</td><td>50 474</td><td>393 757</td><td>100.</td><td>7 7 800</td><td>0.000</td><td>0.000</td><td>0.000</td><td>1,004.4</td><td>-</td><td>% I.O.</td></td<>	i i	50 474	393 757	100.	7 7 800	0.000	0.000	0.000	1,004.4	-	% I.O.
60.393 292.802 973.4 732.0 50.393 242.020 724.0 90.0 50.393 242.020 724.0 90.0 50.393 242.020 724.0 605.0 607.0 50.393 242.020 724.0 605.0 607.0 50.393 242.020 89.792 269.4 216.6 351.4 322.5 50.555 89.792 269.4 224.5 224.5 225.5 50.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	198	50.481	242.000	200	† C	2000	2 200	1184.0	1182.2	4.1.	.0.14%
90.782 292.002 726.1 605.0 607.0 607.0 60.70 60.	3 9	100	243.202	0.53.0	2.56.5	200.0	- PGB	0.1801	1031.2	0.8	0.09%
90.393 242.020 786.1 605.0 607.0 51.079 51.0	3 9	20.782	292.802	8/8.4 	732.0	734.5	734.6	881.5	882.0	2.5	0.34%
50.79 50.79	£ ;	50.383	242.020	726.1	605.0	607.0	607.1	727.0	727.2	2.0	0.32%
950.755 140.548 4216 351.4 352.5 35.255 35.2	<u>83</u>	51.079	191.627	574.9	479.1	480.0	479.9	575.0	575.6	6.0	0.19%
24.675 89.792 269.4 224.5 226.0 24.675 64.538 163.6 13.3 13.75 24.675 24.675 74.0 61.7 61.5 0.0 0.0 0.0 0.0 0.0 MIST CENTIED WEIGHTS Weight ID Weight ID Weight ID Height 8 25.2237 RE 05.00871 155 25.2237 RE 10.01902 165 25.21751 6R 09.44235 175 25.2205 8R 10.00126 195 25.2205 8R 10.00126 195 25.2205 8R 25.2234 25.5234 105 25.5234 25.5234 105 25.5234 25.5234 105 25.5234 25.5234 105 25.5234 25.5235	So	50.755	140.548	421.6	351.4	352.5	352.4	422.0	422.2	1.1	0.32%
29.863 54.538 163.6 166.3 197.5 24.675 24.675 74.0 61.7 61.5 0.0 0.0 0.0 0.0 0.0 MST CERTIFIED WEGHTS Weight LD Weight (Lb) Hanger = 09.8664 155 = 26.52237 2R	δ	35,255	89.792	269.4	224.5	226.0	224.7	269.5	270.0	5.5	0.68%
MIST CERTITIED WEIGHTS 74.0 61.7 61.5	Æ	29.863	54.538	163.6	136.3	137.5	137.4	164.5	164.9	1.2	0.85%
NIST CERTITIED WEIGHTS NIST CERTITIED WEIGHTS WEIGHT (ID) WEIGHT (ID) WEIGHT (ID) WEIGHT (ID) WEIGHT (ID) WEIGHT (ID) R = 09.87989 158 = 26.52237 R = 09.87989 158 = 25.2024 R = 09.87989 158 = 25.2026 R = 10.00126 198 = 25.20228 R = 25.22672 208 = 25.4786 S = 25.2244 218 = 25.47076 S = 25.58444 228 = 25.17076 S = 25.84844 228 = 25.17076	ä,	24.675	24.675	74.0	61.7	61.5	61.4	73.5	74.0	-0.2	-0,30%
Waight ID Weight ID Weight ID 08.6664 135 = 26.55237 05.00871 145 = 24.87054 09.97989 155 = 25.6443 10.01902 165 = 25.21751 09.44235 175 = 25.20028 10.00126 185 = 25.22055 25.22672 205 = 25.2205 25.52344 225 = 25.17076 25.54440 225 = 25.17076		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Weight (b) Weight (b) 09.68644 13S = 05.97989 15S = 09.97989 16S = 09.84235 17S = 10.00126 18S = 10.00126 18S = 15.22672 20S = 25.22672 20S = 25.50234 22S = 25.5024 22S = 25.5			NIST CERTIFIED WE	IGHTS	•					2	
Weight [b] Weight [D] 09.68644 13S = 05.00971 14S = 09.97988 16S = 10.01902 16S = 10.00126 19S = 10.007286 19S = 25.22672 20S = 25.50234 225 = 25.5024 225 = 25.5024 225 = 25.5024 225 = 25.5024 225 = 25.5024 225 = 25.5024 225 = 25.5024 225 = 25.50				STURM							
09.68644 13S = 05.00971 14S = 05.00971 14S = 10.01902 16S = 10.01902 16S = 10.00786 19S = 10.00786 19S = 25.22672 20S = 25.50234 225 = 25.40440 23S = 25.6078 23S = 25.607		Weight ID	Weight (b)	Weight ID	Weight (lb)						
09.70001		Hanger ≖	09.68644	138 =	25.52237						
10.01902 165 = 10.01902 165 = 10.00126 178 = 110.00126 198 = 125.22672 20.5 = 25.50234 225.5 = 25.5024 225.5 = 25		1 04	00070	2 4	25 56443						
09.84235 175			10.01902	# 55 - 84	25.30443						
10.00126 18S = 10.02786 19S = 25.22672 20S = 25.50234 22S = 25.40440 23S = 25.60236 23S = 25.40440 25.4040 25.4040 25.4040 25.4040 25.4040 25.4040 25.4040 25.4040 25.4040		# #	09 84235	178 -	25.28046			(Exan	Example Data Only	_	
10.02786 19S = 25.22672 20S = 25.25314 21S = 25.50234 22S = 25.48440 23S = 25.484		7R=	10,00126	185 =	25,20028						
25.22672 20S = 25.25314 21S = 25.50234 22S = 25.48440 23S = 25.484		88 =	10.02786	19S =	25.25228						
25.25314 215 ≈ 25.50234 225 = 25.48440 235 ≈ 25.64476 245		≖ 88	25.22672	= 20S	25.22205						
25.50234 22S = 25.48440 23S = 25.48440		= S6	25.25314	215 ≖	25.47852						
25,4840 23S =		10S =	25.50234	22S =	25.14300						
36.5 24.76		118 =	25,48440	238 =	25.17076						
= 047 0/460.02 =		125 =	25.59476	24S =	25.18945						

Version 1.0:5/26/94

Attachment B Continued

12/13/94
REPORT
LIBRATION
RQUE CA
ED AND TO
OUTY SPEE
HEAVY-D

Cellmate Shaft		Davtronic Case		Collman Cace						
Torque Offset	% diff.	Torque Offset	% diff.	Torque Offset	% diff.		Speed C	Speed Calibration		
(ft-1b)		(ft-1b)		(ft-1b)						
0.0		0.0		o						
-0.3	-0.47%	0.0	-0.03%	0.2	0.24%	Muti-Counter	Davtronic	% Diff	Collmate	% Diff
9.0	0.41%	9.0	0.24%	0.5	0.30%	Speed	Speed	i 2	Speed	5
-0.2	-0.08%	0.1	0.05%	0.1	0.05%		-			
0.1	%40.0	-0.1	-0.03%	-0.2	~90.0-	200	199	-0.5%	199	-0.5%
0.2	0.05%	0.1	0.02%	0.3	0.06%	200	499	-0.2%	500	%0.0
2.1	0.34%	4.9	0.27%	2.0	0.28%	1000	1000	0.0%	1000	%0.0
3.5	0.48%	3.1	0.35%	2.9	0.33%	1500	1500	800	1500	9
1.9	0.22%	7.0	%90.0	5.1	0.11%	2000	2001		2001	5 4
- 0.1	-0.01%	1.2	0.10%	1.1	0.10%	2500	2501	%00	2500	9
-1.2	-0.11%		-0.09%	6.0-	-0.07%	3000	3005		3001	2 6
-1.7	-0.14%	-2.7	-0.18%	-2.5	-0.17%	3500	3502	,	3501	2 0
					!	4000	4002		4001	9 0
-1.6	-0.13%	-2.7	-0.18%	-2.5	-0.17%	4500	4501	200	4500	2 2
F.#-	-0.10%	9.0-	-0.05%	-0.7	-0.06%			;	,	2
	-0.11%	0.7	0.06%	6.0	0.08%					
6.0	0.10%	Ć.	0.11%	4.1	0.13%					Γ
2.6	0.35%	3.1	0.35%	3.6	0.41%		Torone St	Torque Shunt Values		
2,1	0.34%	0.9	0.13%	7	0.16%		235			
9.0	0.17%	0.1	0.02%	7.0	0.13%					
1.0	0.29%	9.0	0.08%	9'0	0.13%					
0.2	0.10%	0.1	0.05%	9.0	0.23%		Shaft Torque		Sase Torque	
-	0.77%	6.0	0.54%	1.3	0.79%	Prev.	1065.5		1195.0	
-0.3	0.47%	-0.5	-0.71%	0.0	-0.03%	New	1066.0		1196.0	
0.0		0.0		00.00		% Difference	0.05%		0.08%	
į	:		;							
nave performed in	us calibratio	i nave perionned fins calibration in accordance with 1. F. 251.	1 T.P. 251.			U	Exampl	Example Data Only	niy	\bigcirc
Technician Signature	Te				Date					
have validated this	s data in acc	I have validated this data in accordance with TP 251.	_							
Technician Signature	5 -			I	Date					